DETAILED MINERALOGY AND TRACE ELEMENT COMPOSITION OF SILICATE-BEARING IAB IRON METEORITE MASLYANINO.

D. S. Ponomarev[1,2], K. D. Litasov[1,2], A. Ishikawa[3], I. S. Bazhan[1], T. Hirata[4], N. M. Podgornykh[1], [1]Sobolev Institute of Geology and Mineralogy SB RAS, 3 Koptyuga Ave, Novosibirsk, 630090, Russia (denis_ponomarevs@mail.ru); [2]Novosibirsk State University, 2 Pirogova st, Novosibirsk 630090, Russia; [3] Tokyo Institute of Technology, Ookayama, Meguro-ku, Tokyo, 152-8550, Japan; [4]Geochemical Research Center, University of Tokyo, Hongo, Bunkyo-ku, Tokyo, 113-0033, Japan

Introduction: IAB iron meteorites often contains silicate-bearing clasts, which, based on mineralogy, trace element and oxygen isotope evidences, indicative for close genetical relations with winonaites. Here we report first detailed results on Maslyanino iron meteorite, which was found in 1992 (Novosibirsk region) and preliminary classified to IAB irons based on metal composition.

Methods: Several thin 2-4 cm plates of meteorite from Central Siberian Geological Museum (Novosibirsk) were investigated by scanning electron microscope (Tescan MYRA 3 LMU) with energy-dispersive system X-Max-80 (Oxford Instr.). Trace elements composition was obtained by LA-ICP-MS (Thermo Scientific Element XR) method at Tokyo University (Japan). We used homogenous Campo del Cielo iron and synthetic FeNi-metal [1] as standards. Graphite was characterized by Raman spectrometry using a Horiba Jobin Yvon LabRAM HR800 microspectrometer with an Nd:Gd 532-nm laser.

Results and discussion: Maslyanino meteorite is a fine-grained octahedrite. Metal part consists of kamacite and taenite forming Widmanstätten patterns and abundant irregular schreibersite grains. The modal ratio of taenite is 25.3(0.5)%. Silicate inclusions have variable form including separate silicate grains in metal matrix. Large troilite aggregates are associated with silicate inclusions and typically form rounded aggregates along boundaries of silicate clasts. Digitized point counting of minerals in the polished plates (total area is ~20 cm^2) indicates following modal composition: metal = 54-57%, silicates and phosphates = 20-29%, troilite = 14-21%, graphite = 3-5%, and schreibersite = 1-2%. Similar relationships are preserved in large sample sections of 10-20 cm in size.

Silicate (+phosphate) inclusions contain olivine (Fa_{4-6}), orthopyroxene ($En_{88-94}Fs_{5-7}Wo_{1-2}$), clinopyroxene ($En_{53-54}Fs_{3-5}Wo_{45-46}$), plagioclase ($Ab_{72-84}An_{15-25}Or_{3-5}$), apatite (F = 2.3(3) wt.%, Cl = 2.8(3) wt.%), merrillite, and chromite (Mg#=36-40, MnO = 3.7-4.5 wt.%, ZnO = 1.8-2.3 wt.%). Silicate minerals are typical for IAB irons and winonaites [2]. Graphite is abundant inside the silicate inclusions as well as along their boundaries and inside metal, where it forms cliftonite aggregates. Rare daubréelite and altaite (PbTe) we also observed in silicate inclusions coexisting with troilite. Some olivines contain rounded microinclusions of metal, troilite, daubréelite and nickelphosphide (52-54 wt.% Ni). Schreibersite in metal matrix contains 34-37 wt.% Ni.

Average metal composition was calculated using average kamacite and taenite from 12 analyses in 75:25 wt% ratio. Important concentrations include Ni = 9.98 wt.% and (in ppm): Cr = 1.33, Co = 5336, Cu = 339.2, Ga = 31.9, Ge = 118.2, As = 22.4, Mo = 4.38, Sb = 0.65, W = 0.41, Re = 0.15, Os = 1.49, Ir = 1.42, Pt = 2.37, Au = 1.65. Accordingly, Maslyanino meteorite is located between IAB, IIC and IIICD irons at the Ni-Ga and Ni-Ge classification plots, however it falls certainly into IAB group in Ni-Ir diagram. In the Au-Ni based classification inside IAB group [3] Maslyanino falls into the region between the sLL and sLM subgroups and corresponds well to Pitts or Udei Station grouplets.

Trace elements in silicates revealed that orthopyroxene has LREE depleted chondrite-normalized spectra with minor Eu anomaly. Clinopyroxene has M-shape REE pattern and is depleted by Nb and Sr. Plagioclase has positive Eu anomaly and enriched by LREE and Sr relative to other IAB irons. Apatite and merrillite are strong concentrators of REE and Sr, have pronounced Eu anomaly and depleted by Zr and Nb. Apatite contains 11-16 ppm Th and 4.8-5.3 ppm U.

Metallographic cooling rate calculated using central taenite concentrations in lamellae is 30-60 ^oC/m.y., which is very similar to closely related meteorite Woodbine [4]. Two-pyroxene thermometry indicates crystallization temperatures of 982(17) ^oC using Well's (1977) and 909(20) ^oC using Taylor's (1988) thermometers. These values are relatively low taking into account whole range of temperature estimations for IAB irons (950-1200^oC) [5].

The obtained results for Maslyanino meteorite is consistent with basic model of IAB iron-winonaite formation [2] as a result of catastrophic impact event, which caused removal of outer chondrite-winonaite shell. The minor impacts on the rest of parent body formed IAB irons (including those with silicate inclusions) and winonaites.

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